

Idotea linearis, Pennant; B. & W. *op. cit.* ii. p. 388.

Common in 3 or 4 fathoms on sand near the bar of the Eden, in the trawlers' boats, and in the stomachs of the common fishes. They are active swimmers.

Messrs. Bate and Westwood state that I sent *Cymodocea truncata*, Mont., from St. Andrews; but this is doubtful. The specimens probably came from the Outer Hebrides.

Division AEROSPIRANTIA.

Fam. Oniscidæ.

Genus LYGIA, Fab.

Lygia oceanica, L.; B. & W. *op. cit.* ii. p. 444.

Abundant at the margin of high water at the East Rocks.

A specimen of *Porcellio scaber* occurred in the stomach of a cod.

Order CUMACEÆ.

Fam. Diastylidæ.

Genus DIASTYLIS, Say.

Diastylis Rathkii, Kröyer.

Common off the East Rocks in 3 to 4 fathoms, and in the stomach of the cod, haddock, and flounder.

[To be continued.]

XXXIV.—“Eozoon” examined chiefly from a Foraminiferal Stand-point. By Professors W. KING, Sc.D., and T. H. ROWNEY, Ph.D.

[Plate XIX.]

LIKE most scientific men, it has been the lot of Dr. Carpenter, in the course of his career, to be placed under the necessity of defending certain of his views against the opposition of others. But unlike many who could be named, and who have risen above petty personal feelings, he does not scruple to speak of his opponents, or discuss their arguments, in a way ill-befitting any

one that "loveth truth better than system"*. No other alternative, however, is open to us but to leave Dr. Carpenter to indulge in what he always imbues with a spirit of genuine sincerity, though it may recoil on himself to an extent that we, with others, cannot but regret.

It will be recollected that in the May number a summary was given of the evidences and arguments that have been advanced by us against the "eozoic doctrine." Of the twenty-one points contained in that summary, Dr. Carpenter has only grappled with two, the 9th and 19th (one relating to the "nummuline wall," and the other to the "canal-system" †); the rest, as may be presumed, appearing to him to be "entirely destitute of logical force." Of course, those that are noticed must be of a different character. Let us see how *they* are treated, as we may then be able to judge whether he has not displayed considerable exemplary discretion in not "troubling" himself with the remaining nineteen.

"Nummuline Wall" or Acicular Crust.

In our first memoir we noticed the fact, previously mentioned by Dr. Carpenter, that the aciculæ "sometimes pass off very obliquely, or even tangentially, so as to run for considerable distances in the chamber-walls;" also his admission that

* Exceptions to any objectionable rule ought to be frankly acknowledged. "The accuracy of Prof. King's information of Micro-Palæontology may be estimated by the fact that when (about the same time) he made his first acquaintance with the *Orbulina universa* brought up in the 'Porcupine' soundings off the west of Ireland, he forthwith described them as not improbably affording the explanation of the granular concretionary structure of the *Oolites*." I confess to feeling myself under great obligation to Dr. Carpenter for having drawn the reader's attention to a fact nearly forgotten, and evidently of much importance in my favour; but, doubtless, influenced by a laudable desire not to occupy so prominent a position as his share in them justly entitles him to take, my colleague felt himself under the necessity of making no reference to our joint micro-palæontological labours on *Rhynchopora Geinitziana*, *Spirifer cuspidatus*, and the "Histology of the Palliobranchs" that have appeared in preceding volumes of the 'Annals' (1856, 1865, 1868, &c.) and other publications.—W. K.

† Dr. Carpenter, we find, makes some slight reference to two or three other points. What he states in connexion with the 16th does not apply to *our* arguments, which were against his *quasi-alchemy* explanation (see 'Intellectual Observer,' vol. vii. pp. 290 & 294) of a number of untoward difficulties frequently presented by the "proper wall" and "canal-system," and which *cannot be ignored* in any criticism on these parts. As to the 20th point, it must astonish those belonging to the Canadian Geological Survey to learn that all the essential features of "Eozoon" occur in the highest state of preservation in specimens showing the least evidence of any mineral change.

he has "seen no parallel to this disposition in other Foraminifera." We, therefore, expressed ourselves as being disposed to regard so anomalous a peculiarity as evidence on our side. Mr. H. J. Carter (without, we suspect, being aware of the above admission, or of the view we were inclined to take), when he became acquainted with the anomaly, belonging, be it observed, to a part "by which the organic origin of *Eozoon* is capable of being most unmistakably recognized," emphatically pronounced against the identification of this part with the chamber-wall of a Foraminifer, and no wonder.

Mr. Carter mentions that the aciculæ are "sometimes observed to be standing perpendicularly on, but much more frequently parallel with, the surface of the grains of serpentine:" and Dr. Carpenter, in his first reply, "freely admits" that this "fact" is one of "two anomalies in the arrangement of the" aciculæ*; but, not being able to meet it, he runs off by appealing to "the wonderful variability of the Foraminiferal type, &c." However, in his second reply (having, apparently, just made the discovery), he states, "I now find a perfectly simple explanation of the fact in the structure of those very *Nummulites* which Mr. Carter knows so well." The explanation is afforded by a figure, "after D'Archiac and Haime," representing the tubulation of *Nummulites levigatus*, which tubulation, we are given to understand, is "the precise counterpart to" the parallel aciculæ of "*Eozoon canadense*."

Considering the admissions made by Dr. Carpenter, we were certainly surprised to learn from himself that similar counterparts are abundantly represented by D'Archiac and Haime in their 'Animaux Fossiles du Groupe Nummulitique de l'Inde.' We have no intention of criticising the figure that has been copied; for the original was made when the minute structure of the shell-layers of a nummulite was only imperfectly known. Having, however, some knowledge of the "pillars" or "cones" (so called by Sowerby) belonging to these layers, but respecting which various opinions have been advanced, we refused to put any faith in the explanation until the true character of the "pillars" and their relation to the chambers became known to us.

Within the last few months we have been kindly favoured by Mr. Carter with the loan and presentation of some valuable specimens of recent and fossil Foraminifers, together with copious information; so, when the "precise counterpart" came under our observation we solicited his further favours. The specimens he sent us in return were exactly what were re-

* The other anomaly will be noticed hereafter.

quired: a slide which he had specially prepared for us, containing *Nummulites broachensis* infiltrated with mineral matter, is particularly instructive.

Before offering any opinion on the alleged "explanation," we shall make a few remarks preparatory to its consideration.

All the *investing* chambers* of a nummulite are individualized by *walls* and a *roof*†—the former being vertical or variously inclined to the plane of the median chambers, and the latter more or less parallel to the same plane. The roofs form an important portion of the shell-layers of which a nummulite consists: and the walls, besides bounding the chambers laterally, *extend upwards*, passing through the suprajacent layer. Frequently, a number of walls are piled above each other, and the roof of one chamber serves as the basement of another. The walls are usually thin, but widest at the top; occasionally thick, as when situated at the junction of three or four chambers: the wall-extensions are often thicker, especially in the latter case. Both are pellucid. They form the "pillars" or "cones" (inverted) previously alluded to. In certain species (probably in all) the walls exhibit an asbestine or fibrous structure, the divisional lines being at right angles to that portion of the layer to which they individually belong. The roofs (possibly also asbestine) are opaque, of considerable areal extent, and generally thick: they are everywhere penetrated by fine tubules, which lie parallel to the above divisional lines.

It will thus be understood that every chamber is separated from those adjoining by a vertical asbestine wall, and that every layer is made up of roofs and walls. The layers, consequently, consist largely of tubular, and, to a much less extent, of asbestine portions, in alternating order‡. Through various peculiarities characteristic of, and irregularities incidental to the

* The *median* chambers require no particular notice, not being directly concerned in the present question; and, for the same reason, only incidental allusions are made to the "canal-system."

† Believing that they are more explanatory, we have given these names respectively to the parts usually called *septa* and *wall*: the latter is often designated "*nummuline layer*," &c., from being tubulated, as in the Nummulites.

‡ The resemblance of the asbestine to the fibrous structure of arragonite is so close as to suggest that, instead of being original, as assumable, it may be superinduced and of inorganic origin, resulting from fossilization. Much could be said in favour of this view: nevertheless, in most cases of a change of the kind stated that have come under our notice, the process has been more or less destructive of original structure, obliterating the difference between the roof and the walls, or converting alike their substance into a structureless and pellucid condition, often so unequally, that certain laminae of the shell-layers are opaque, and show

layers, the chambers, and the walls, vertical and oblique sections of a nummulite are rarely without some apparent deviations from the general plan of structural arrangement.

We have represented in figures 1 and 2 (Pl. XIX.), as faithfully as our abilities will allow, two medio-vertical sections, displaying the forementioned characters. Fig. 1, a section of *Nummulites levigatus*, as seen magnified 120 diameters, shows a portion of two layers, between which is a series of investing chambers (*a*), and underneath other three that are median (*a x*). The walls (*c*), including their extensions (*c x*), pass through the layers with a slight curve: it is noteworthy that one of them ends at the floor of an overlying chamber. The only structures discernible in these parts are a few transverse lines, which characterize the entire layers, and evidently belong to their constituent laminae. The chamber-roofs (*b*) are distinctly tubulated, as represented by the black lines: the tubules run straight out for the most part, but with a slight curve occasionally*. Fig. 2 represents a section of *Nummulites broachensis* (attached, with five more, to the slide presented to us by Mr. H. J. Carter)—a tumid species, with its different parts less repetitively developed than in many others. The chamber-roofs (*b*) have the tubules (marked in the figure by dark lines) filled with yellow (?hydrous) oxide of iron†; causing them to appear strongly in contrast to the white semi-opaque walls (*c*, *c x*): the latter parts everywhere display a fine asbestine structure. Every layer, besides being tubular and asbestine, is distinctly laminated, the laminae traversing

traces of tubulation, while others in *immediate* connexion are perfectly pellucid and structureless. We have never seen asbestine structure in *Nummulites levigatus*; but in another species, from Biarritz, the walls exhibit a vertical lineation, though indefinitely, which appears to be due to it. Whether the structure be original, or superinduced does not affect the question; for the parts characterized by it, if they were even structureless, would be different from the roofs. Mr. H. J. Carter has delineated the walls and their extensions ("columns of condensed shell-substance") of *Orbitoides dispansa*, with something like a prismatic structure (Ann. Nat. Hist. 3 ser. vol. viii. pl. xvi. fig. 1 *d*), which may be asbestine; or, possibly, from being fasciculated and divergent, it is due to the canal-system: if the former, the case is the only one known to us, with the exception of the doubtful one represented by D'Archiac and Haime, of the asbestine structure having been published. Mr. Carter, however, has been for some time acquainted with it in *Nummulites broachensis*: and it was from him we first got our information on the matter.

* The roof and wall belonging to the median chamber on the left side are broken: they lie below the plane of the section, and therefore come out indefinitely.

† The chambers, also the canals, are filled with a red variety, which may be anhydrous oxide of iron.

continuously both roofs and walls. A few exceptional appearances occur: a bundle of tubules intersects two or three layers (one seems to be interpolated) in a mass of asbestine shell-substance, but without any chambers. The absence of the latter is evidently due to their being cut off from the section.

Furnished with what may be deemed sufficient data, we may now pause to take into consideration the figure brought forward by Carpenter, "after D'Archiac and Haime."

What does the figure show as it appears?—or, what are we to understand from it, as described by Dr. Carpenter? Evidently (1st) that the layers are everywhere lined; and (2nd) that the lineation is to be taken as representing tubules, not only in the roof of the chambers, but as "*passing by*" their ends or sides. Now we unreservedly declare that no section of a nummulite can show in reality, except accidentally, any thing of the kind.

Every chamber, as we have shown, is circumscribed by walls. The lineations adjoining or *passing by* the ends of the chambers, represented by D'Archiac and Haime, must, if they were really present in the specimen, belong to the walls and their extensions; so that instead of indicating the presence of tubules, they can only represent asbestine divisional lines. The French *savans* may not have been acquainted with the difference between the walls including their extensions and the roofs of the chambers (we are not able to consult their work): if this were the case, much could be said in their favour. But nothing of the kind can be urged on the side of Dr. Carpenter; who, with all the modern appliances at his command for obtaining, if necessary, the information, and more especially after having, on different occasions, described and figured the walls as "pillars" formed of "solid substance not perforated by tubuli," deliberately brings forward this case, declaring oracularly that it is the "*precise counterpart to*" what has been admitted by himself to be an *anomalous fact*, and which is regarded by Mr. Carter and ourselves as "incompatible with nummuline tubulation" *.

* We have just had the opportunity of reading Mr. Carter's valuable communication in the current number of the 'Annals,' "On the Striæ of Foraminiferous Tests." The general structure of the nummulite he has sketched out makes it clear that there is nothing in "Eozoon" answering (except *mere simulations*) to any thing in a foraminiferal shell. Mr. Carter's *striæ* form our *asbestine structure*, which it would appear is not uncommon among fossilized nummulids. We cannot bring ourselves to accept unconditionally the view that "the striæ are the lines of cleavage," although a number of considerations could be urged in its favour: the close conformity in direction between the striæ and the adjoining tubulation seems to be relative, and therefore militating against it; while, on

Entertaining no doubt that Dr. Carpenter perfectly understood the point which he so confidently pronounces "betrays" our "shocking state of ignorance of Foraminiferal structure," we cannot but give expression to our astonishment at the evidences he has brought forward by way of justifying himself.

"*Eozoon*" is stated to be furnished with chambers that have an *upper* as well as an *under* "nummuline" or "tubulated wall" (a roof and a *floor*), also an "intermediate skeleton" between them; added to which it must be understood that the tubules (aciculæ) of the "walls" often pass continuously from one chamber to another to the exclusion of the skeleton*. Notwithstanding the "wonderful variability of the Foraminiferal type," we have invariably held that the presence of an upper and an under "wall" is a pseudopodial impossibility; while it has been "freely" admitted by Dr. Carpenter, but only lately ('Annals,' April, p. 282), that the "fact" is an *anomaly*†. Determined, however, not to be outdone, he copies a figure, by Carter, representing a vertical section of *Orbitoides dispansa*, in which, it is stated, the "pseudopodial tubulation normally passes," and is circumstanced, as in "*Eozoon*." But, unfortunately for this statement, neither *Orbitoides dispansa* nor *Nummulites* possesses any intermediate skeleton, or an *under* "tubulated wall." The tubulation that is present is *upper*: it belongs absolutely and essentially to the *roof* of the chambers. We challenge our opponent to point out a single "fact" among the entire group of Foraminifera enabling him to get over this stumbling-block. Even in *Calcarina* (stated to be "the nearest parallel to *Eozoon* among recent Foraminifera"), which possesses an intermediate skeleton, a "tubulated wall" is wholly absent from the *bottom* of the chambers, every one of which *rests directly on* the skeleton.

Dr. Carpenter would fain wish it to be understood that we have *never seen* what he emphatically calls "my true num-

the other hand, the organic development of the asbestine structure (in other words *prismatic*) is supported by certain observations made by Dr. Carpenter, which show that in *Operculina arabica* the tubules of the chamber-roofs are each in the *centre of a prism* (see 'Introduction to Foraminifera,' pl. xvii. fig. 8, p. 256). But the subject is one that requires much more attention than has yet been given to it; and the bearing thereon of Mr. Carter's discovery of some instances of rhombohedral (true) cleavage in fossilized nummulites must not be overlooked.—August 12, 1874.

* See Quart. Journ. Geol. Soc. vol. xxi. p. 63; Intellectual Observer, vol. x. pp. 294, 295, tinted pl. fig. 1 (upper part left-hand side); Popular Science Review, vol. iv. pl. xv. fig. 10.

† This is the second of the "two anomalies" previously mentioned.

muline wall;" yet he inconsistently asserts, "if the chambers and tubuli of a nummulite were infiltrated with serpentine, and the calcareous skeleton were removed by acid, the appearance presented would be exactly that figured" in one of our delineations of it.

Referring to his original description of "*Eozoon*," we find it stated that "in decalcified specimens, the free margins of the casts of the chambers are often seen to be bordered with a delicate white glistening fringe; and when this fringe is examined with a sufficient magnifying-power, it is seen to be made up of a multitude of extremely delicate *aciculi*, standing side by side like the fibres of asbestos:" and reference is made to fig 4, pl. ix., accompanying the memoir. Dr. Carpenter asserts that "Professors King and Rowney *certainly have not seen*" any thing answering to this description, "if they can identify it with a film of chrysotile or asbestiform serpentine, and can assert that in its typical condition it occurs in cracks or fissures of the serpentine." As the figures which represent the fact that sustain this identification (somewhat incorrectly expressed by Dr. Carpenter) are contained in a publication less known, considering its merits, than it ought to be, we have selected two additional examples, detected in a mounted section, kindly presented to one of us by himself some years since, of "*Eozoon*," in its *laminated* condition, from a specimen of Canadian ophite*. In the examples represented in fig. 3 "extremely delicate aciculæ" (*b*) are seen "standing side by side," exactly as in Dr. Carpenter's illustration; while in the other, given under fig. 4, similar aciculæ occur, but more obviously separated. The latter may be taken for typical examples of the "nummuline wall"—the "calcareous lamella perforated by minute tubuli" (they show the calcareous separations removed by decalcification, the casts of the tubuli alone remaining). But now comes the point which is to decide whether *we* are labouring under "confusion in the mind," or Dr. Carpenter is "suffering under tubulation on the brain." Reverting to the example represented in fig. 3, the aciculæ are seen to "stand side by side" (when, of course, the interspaces must be much thinner than they are in example fig. 4), and to be closely compacted, with absolutely nothing more separating them than their own divisional lines; and as such they pass here and there into the condition of true chrysotile (*c*), which actually runs into, and forms a *vein* in, the adjacent serpentine (*a*), retaining the green colour of the structureless mineral. The change from one

* The entire section is represented in 'Proceedings Royal Irish Acad.' vol. x. pl. xli. fig. 4.

extreme to the other, in this the most demonstrative example we have yet met with, is without a break or interruption of any kind.

We have no doubt that Dr. Carpenter has often seen examples resembling the above; but, considering that they are called by him "pseudomorphs," considerable doubts may be entertained of his being "perfectly acquainted with" them. Be this as it may, he "freely admits their resemblance to certain forms of the acicular layer left after decalcification of the nummuline layer." To us the resemblance is too close—of too graduating a character to be dismissed in this manner. Dr. Carpenter will have, therefore, still to repeat—"Professors King and Rowney persist in likening them, notwithstanding *my repeated assertions* that the two things are altogether different"*.

So, proofs of the complete passage of the "true nummuline wall" into chrysotile or fibrous serpentine, and exhibited in a highly metamorphosed rock with a complex mineral composition, are to be set aside by mere assertions, based on nothing more than simulations, and made, too, by one who rightly confesses that he is "not a mineralogist."

It is quite unnecessary to bring forward any other cases than those elsewhere made known † to show that the "nummuline wall, in its typical condition, occurs in cracks or fissures of the serpentine." It so happens that one of the cases referred to is seen in the section which has yielded the demonstrations that have been described and figured.

We have all along maintained that the "nummuline wall" is an integral portion of the grains and other aggregations of serpentine which it invests: hence, when a "constructed" figure was continually being republished, and which, by representing the "wall" with two continuous bounding lines, made it appear as a part independent of the skeleton, like the chamber-roof of a *Calcarina*, we deemed ourselves called upon to make known the objection we have to such representation.

Specimens are abundant which show the surfaces of the grains gradually changing into the "nummuline wall," and consequently proving the latter to be, not an independent part, but an acicular variety of the serpentine. The specimens last under consideration are evidences in point; and we give, under fig. 5, a representation of another specimen to sustain more

* The italicization is ours.

† See Quarterly Journal Geol. Society, vol. xxii. pl. xiv. fig. 4, p. 196; Proc. Royal Irish Acad. vol. x. pl. xliii. figs. 5, 6.

directly our objection. It will be observed that the side of the "wall" in contact with the serpentine (*a*) (in eozoic parlance, the face of a "chamber") exhibits a number of serpentine extensions or openings of various widths without aciculæ. Openings of a similar character are not uncommon on the other or calcitic side of the "wall" (*d*), called the "intermediate skeleton," though they do not occur in the specimen now under consideration*. In some cases the serpentine extensions are slender rods, and pass right across the "wall."

Both sets of openings are represented by Dr. Carpenter in the "nummuline wall" of the "constructed" figure to which we make objection; but he has represented them bridged over by a continuation of the line defining the acicular portions, as will be seen by our enlarged and roughly approximate copy of a portion of the "wall," under fig. 6. The openings on the "skeleton" side (*d*) consist of calcite; those on the opposite or "chamber" side (*a*) we have represented filled with serpentine, as warranted by fig. 5. To some observers, endowed with the gift of foraminiferizing †, the latter openings might be, and, if we are not mistaken, have been regarded as due to "pillars of non-tubular" shell-substance, similar to the wall-extensions that intersect the layers of a nummulite; but this view is obviously incorrect, as it requires the openings *belonging to both sides to be filled with calcite, also to be extensions of chamber-walls*: nothing, however, that can be considered to represent any thing of the kind is ever present. Clearly, then, as the openings cannot be identified with the non-tubular portions belonging to the shell-layers of a nummulite, they ought to have been represented unbridged, as in fig. 7. Dr. Carpenter had no more right to introduce bridging lines than we have in our fig. 5. It may be suggested that he has merely given a hypothetical reconstruction; but nothing of the sort can be allowed after his express declaration—"I have represented nothing that my specimens do not

* As, from their similarity of composition, we cannot demonstrate any difference between the "intermediate skeleton" and the adjoining *calcitic openings*, and as it is immaterial to the point, it is unnecessary to make any further allusion to the latter.

† It is much to be feared that the spheroids, &c., common in the magnesian limestone of Durham, will not escape being converted into gigantic Foraminifers. Dr. Carpenter, after making some remarks in connexion with these bodies, thus concludes—"The only question now is, whether a careful microscopic examination of the minute structure of the Permian concretions may not afford, through its likeness to that of *Parkeria*, more or less definite indications of *their* organic origin obscured by subsequent metamorphism"! (Nature, vol. iii. p. 186). The late Professor Sedgwick, in a letter to one of us, spoke strongly against the "eozoic doctrine:" what would he have said respecting this idea?

distinctly show." Observations properly and patiently conducted, with a true appreciation of all the collateral elements, and discarding partial simulations, instead of giving rise to the idea that the openings on the "chamber" side should be represented as bounded by a line and filled with calcite, would have resolved them into portions of serpentine, remaining unconverted into chrysotile or into the acicular condition.

It will now, to some extent, be understood in what sense we contend that the "nummuline wall" is not a chemically differentiated part. In certain places, as shown on the left side of fig. 4, it is largely made up of calcite (it may be dolomite, or magnesite); and, as such, shutting out of view the fact that it oftener consists of closely compacted aciculæ, it might, allowing some exaggeration, be called "a calcareous lamella"; but in these places the "wall" certainly cannot be regarded otherwise than as having assumed an exceptional condition, it being, according to its discoverer, "rarely well preserved" (the expression evidently refers to what is considered to be its "true" or "typical" character); and, which is of far greater weight with us, more especially when, as in the places already noted, it completely and insensibly passes into the state of *true* chrysotile*.

Dr. Carpenter has brought forward an entirely new "probative fact," consisting of a fragment of the "nummuline

* According to our theory, stated elsewhere (Quart. Journ. Geol. Soc. vol. xxii. pl. xiv. fig. 2, p. 192; Proc. Roy. Irish Acad. vol. x. pl. xli. fig. 2, p. 315; Geol. Mag. Jan. 1872), the presence of calcite in the "nummuline wall" is the result of chemical action, effected by the agency of carbonated solutions, similar to what has taken place in the production of pseudomorphs consisting of calcite after a silacid mineral. In the latter, the original mineral substance is often represented by a siliceous skeleton, or it is entirely removed, nothing being left but its crystalline form composed of calcite. With the exception that no original crystalline form is preserved (for a rock mass has been dealt with), the "wall" displays similar changes; the calcite has partially, or wholly replaced the serpentine—partially where the aciculæ are imbedded in it, and wholly where they are absent. The aciculæ, when separated merely by divisional spaces, manifest the first change of the chrysotile (which is *indefinitely fibrous*): when separated by calcitic interspaces, as in the "*true* nummuline wall," they are no more than the remains of the latter mineral, preserving in their "usual straight and parallel lie," and their "often more or less curvedness," its characteristic *fibrosity*. Similar chemical action, or methylosis as we have called it, has converted amorphous serpentine into lobulated grains ("chamber-casts") and arborescent forms ("canal-system"), but mainly shaped by irregular *conchoidal* divisional structure. In all cases the change terminates with the production of the "intermediate skeleton," the result of the conversion of serpentine into calcite.

wall," in which it is stated that "many of the tubuli remain empty; and they can be distinguished as tubuli under any magnifying-power that the thickness of the covering-glass allows to be used." If we are correct in our interpretation of this statement, we think, although pronounced with italic emphasis, that it ought to have been accompanied by some confirmatory information. The "explanation" of the figures representing the fragment is even less satisfactory. Dr. Carpenter must excuse us; but he ought to know that a mere statement of this kind is totally insufficient to convince those who thoroughly disbelieve in "Eozoon." What may appear to him to be *empty tubuli* cannot appear as such to the latter, unless they are convinced of the validity of the evidence on which he relies. Microscopic appearances are often difficult of interpretation. Besides, it must not be forgotten that Dr. Carpenter is as fallible as any other mortal*. To us this case does not add a single particle of weight to the "eozoic doctrine." Having been brought forward without one iota of evidence, we are under the necessity of making no further comments on it, except to state that we do not dispute but the fragment exhibits some structural peculiarity giving rise to *appearances* of empty tubulation; but being familiar with numerous things in various minerals which cannot possibly be what they are in appearance, as well as with tubular cavities in the same of inorganic origin, we unhesitatingly demur to Dr. Carpenter's interpretation,—more especially as it involves the existence in their *original empty* condition of *fossilized* tubules, stated to be "less than $\frac{1}{10000}$ part of an inch in diameter," and preserved in a well crystallized and complexly mineraliferous rock, like ophite, that has participated in all the mechanical and physical movements undergone by the violently disturbed and highly metamorphosed Laurentians of Canada. It was hard enough for geological or mineralogical believers (full exception must be made in favour of those belonging to the biological class) to accept "the fact that the organic structure of the shell is in many instances even more completely preserved than it usually is in the Nummulites and other *Foraminifera* of the Nummulitic limestone of the early Tertiaries" †, or the statement that "Eozoon" is best preserved in the Laurentians of a "highly

* It will not be the first time that Dr. Carpenter has committed some grave errors, even in cases surrounded by no such difficulties as pertain to the one under notice. We need only mention his idea, apparently held for some years, that the "solid pillars" of the Nummulites were perforations filled up with mineral matter. Of course we attach nothing more to this error than its pertinency to the case of the "empty tubuli."

† Carpenter, Quart. Journ. Geol. Soc. vol. xxi. p. 64.

crystalline condition"*; but any attempt to accept the "probative fact" of *nummuline* tubules, in their original "empty" state, occurring in such rocks, they will find to be labour in vain; though, science failing, Faith, which removes mountains, will undoubtedly stand in its stead.

Is it surprising that Professor Schultze, when he became acquainted with the evidences adduced in our papers, requested his friend, Mr. Arthur E. Barker, "to tell Messrs. King and Rowney, that, with respect to the proper wall of Carpenter, I am entirely of their opinion, that it is of inorganic origin"†; or that Carter emphatically declared the identification of it with the chamber-roof of a nummulite "to be nonsense!"

"Canal-system" or Serpentinous Arborescences.

Our remarks on this part must be comparatively brief, Dr. Carpenter having advanced nothing new respecting it. We must, in the first place, express our approval of his figures 3 and 4, which show the "canals" under their characteristic aspect; also the non-acicular portion of fig. 1, in which some simpler forms are represented; though we are as confident as ever that they are nothing more than examples of arborescent serpentine, related to, if not identical with, metaxite. As regards those shown in fig. 5, their appearance is so untypical that we cannot avoid expressing a fear about our being correct; we are nevertheless willing, with some reservation, to allow them to stand as examples of the "canal-system." The bodies taken to represent this system in the figure last referred to, it is stated, "show by their semiopacity in one part the extent to which the serpentinous infiltration has proceeded, and, by their transparence in the rest, that their canalization is not the result of any foreign infiltration whatever." It is next stated that the "canals" (?presumably the transparent portions) "are filled with calcite, having the same crystalline axis as that of the matrix." Again, "as I know them (the "canals filled with calcite") to be contained in the section which I long since forwarded to Prof. Rowney, the only conceivable reason for the non-recognition of them by the two Galway professors is that they have not used the reduced light, which, through the extreme transparence of the minuter canaliculi, is necessary to bring them into view." As Dr.

* Dawson. This statement is quite correct in the sense that the structures forming the presumed organism are of mineral origin.

† Dr. Carpenter has credited us with many things: his last favour of the kind, that Max Schultze "had changed his opinion respecting the canal-system, as asserted by" us, we are under the necessity of returning—it being without any endorsement.

Carpenter has totally ignored the report we gave of our examination of the section in question, we shall give the substance of it, which, with a few additional remarks, will be sufficient to enable the reader to understand the estimate we have formed of the last case he has brought forward.

We stated that the section was crowded with "canals," distinguished as usual by their semiopacity: intermixed with them were others (encircled by the donor with ink) quite colourless or transparent, and not visible under full light. They were imbedded in transparent calcite, affected with both rhombohedral and macro-diagonal cleavage; but while in most there was nothing of the kind seen, a few had the appearance of possessing calcitic divisional structure. To make ourselves certain with respect to the composition of the transparent "canals," we tested them. Obviously, if they consisted of calcite, the section, when *superficially* dissolved (to prevent their dropping out), would display them quite as much acted on by the acid as the matrix. But instead of this being the result, all the transparent "canals" distinguished by a circle in ink were seen projecting out of the remaining portion of the matrix as clear as glass: none showed any traces of cleavage except one, *where it was still overlaid by calcite**. This simple test completely demonstrated that the transparent "canals" were entirely siliceous bodies.

At various times we have been told of the occurrence of "canals filled with carbonate of lime of the same nature"—"of the same crystalline character"—"having the same crystalline axis as that of the matrix." Taking this to refer to cleavage (for such is represented by lines obliquely crossing the transparent "canals" in Dr. Carpenter's fig. 5; *the same lines*, it will be observed, are *represented (!) equally crossing the semiopaque or "serpentinous canals"*), and, considering the absence of all allusion to chemical and optical evidences confirmatory of their alleged composition, we are strongly inclined to the belief that the crystalline character observed in the "transparent canals," of late made known, does not belong to them, but to their calcitic matrix; and, as in other cases of the kind, it is our opinion that there are the strongest grounds for removing *this* "cardinal fact" from the category of reliable evidence on the side of the "eozoic doctrine."

* A figure was appended of a portion that had been marked with ink, showing five of the "transparent canals," as seen magnified 210 diameters, and under Webster's condenser with graduating diaphragms. For a full account of this section, and specimens of a similar character, the reader is referred to the 'Proceedings of the Royal Irish Academy,' vol. x. pp. 532, 534, 535, pl. 44. fig. 11; also *id.* new series, vol. i. p. 132.

It will be understood from the title of our paper that we have restricted ourselves chiefly to the speciality which, admittedly, Dr. Carpenter ought to be thoroughly conversant with. Fully examined from his own special stand-point, the "nummuline layer" or "feature by which *Eozoon* is capable of being most unmistakably established" turns out to be a *Foraminiferal impossibility*; while, as made known by the twenty-one points of our summary, geology, mineralogy, and chemistry irresistibly relegate it to the domain of inorganic nature. Let us hope, for the reputation of geology, which owes so much to the correlative sciences, that in future its labourers will be severely critical on new doctrines—that before accepting them they will give more weight and consideration to opposing evidences belonging to mineralogy and chemistry; otherwise the noble legacy which they have received from a generation that has scarcely passed away will assuredly fall a prey to sensational doctrines, based on mere *appearances* and *probabilities* uncorrelatively and isolatedly interpreted in opposition to the teaching of a wide range of established facts.

EXPLANATION OF PLATE XIX.

- Fig. 1.* Vertical section of the shell-layers of *Nummulites lævigatus*, showing the chambers (*a, a x*), each with a tubulated roof (*b*), and non-tubular walls (*c*) including their extensions (*c x*): as seen magnified 120 diameters.
- Fig. 2.* Vertical section of *Nummulites brochensis* (Carter). (The letters refer to the same parts as in fig. 1.)
- Fig. 3.* Section (decalcified) of *Eozoon canadense*, showing "chamber-casts" (*a*) in serpentine, "intermediate skeleton" (*d*) in calcite (dissolved out by decalcification), and "nummuline wall" (*b*) in its *typical* condition (the aciculæ were separated by calcitic spaces) where the letter is opposite, but passing *gradually* into chryso-tile (*c*), which forms an intersecting vein in the serpentine: as seen magnified 60 diameters.
- Fig. 4.* Section (decalcified) of "*Eozoon canadense*" (from same specimen as the last), showing "nummuline wall" (*b*) in its *typical* condition, on the left side, but gradually passing into the *closely compacted* condition (*unseparated* except by mere divisional lines) above letter *a*.
- Fig. 5.* Section of same, showing the side of the "nummuline wall" next to the serpentine (*a*) with *openings*, to prove that it is only differentiated from the latter by its acicular or fibrous structure; the serpentine in the openings remaining structurally unaltered: as seen magnified 210 diameters.
- Fig. 6.* Approximate copy, enlarged, of Dr. Carpenter's representation of a portion of the "nummuline wall" of "*Eozoon canadense*," which he has represented bounded by two continuous lines under the belief that it is a "calcareous lamella," and thus differentiated from the serpentine "chamber-cast" (situated on the side *a*).

The bounding-line, or rather the lines bridging the *openings* (a), we contend ought not to have been introduced.

Fig. 7. Same, as the "nummuline wall" really occurs, there being nothing in specimens, as will be seen in fig. 5, to show that the *openings* (a, fig. 6) were ever filled with calcite (according to the "eozoic doctrine" the part is a "calcareous lamella"): on the contrary, they were always filled with serpentine.

XXXV.—On a Collection of Hemiptera Heteroptera from Japan. Descriptions of various new Genera and Species.

By JOHN SCOTT.

NOT the least interesting amongst the many novelties obtained by Mr. George Lewis in Japan are the Hemiptera, which I have had the pleasure of examining; and although the major part of the collection contains many well-known forms, some of which are European, on the other hand there are several possessing peculiar characters. These last are all entirely new to science; and their description forms a portion of the present paper. Subjoined I give a complete list, showing which genera and species are new and which have been previously described.

List of Hemiptera Heteroptera collected by Mr. George Lewis in Japan.

Those species with an asterisk (*) in front are found in England.

Those species with an obelisk (†) occur on the continent of Europe, but are not known to be British.

Fam. PACHYCORIDÆ.

Pœcilocoris ornatus, Dallas.
Callidea grandis, Thunb.

Fam. EURYGASTRIDÆ.

Bolbocoris reticulatus, Dallas.
**Eurygaster maurus*, Linn.
†*Graphosoma lineata*, Linn.

Fam. PODOPIDÆ.

Scotinophora lurida, Burm.
— *tarsalis*, n. sp.

Fam. ODONTOSCELIDÆ.

No representative.

Fam. PLATASPIDÆ.

Coptosoma cribraria, Fab.
— *biguttata*, Motsch.

Fam. OXYNOTIDÆ.

No representative.

Fam. ASOPIDÆ.

**Zicrona cœrulea*, Linn.
Menida violacea, Motsch.
Picromerus Lewisii, n. sp.
Pinthæus sanguinipes, Fab.

Fam. CYDNIDÆ.

Æthus nigropiceus, n. sp.
Macroscytus japonensis, n. sp.
Canthophorus niveimarginatus,
n. sp.
Sehirus triguttatus, n. sp.

Fam. SCIOCORIDÆ.

Laprius varicornis, Dallas.
Drinostia Lewisii, n. sp.